Test Readiness Diagnostics

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The goal is to reduce the time required to field a underground test

- Initial target is a 24 month Readiness Posture
- With approval, transition to an 18 month Readiness Posture by the end of FY 2005

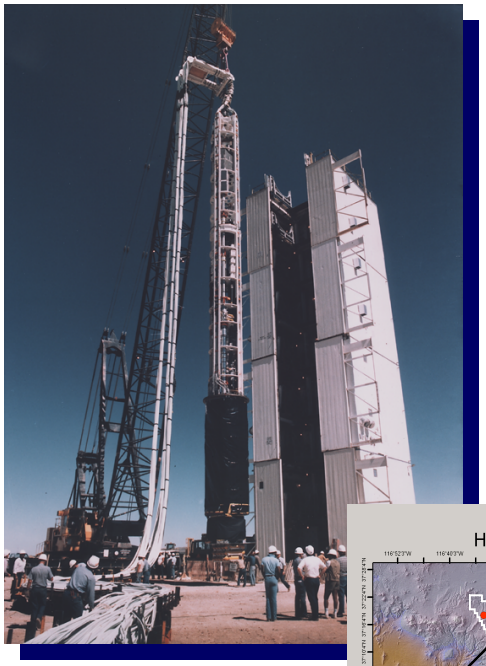
- This work involves close coordination with other organizations
  - LANL
  - SNL
  - Bechtel Nevada

To help organize our efforts, LLNL is designing Operation Popout

Goal: to build test specific expertise by developing a containment plan, line of sight designs, detector coverage's and shielding designs for a hypothetical test

- Simple to moderately complex test
- Assumes Gabbs canister modified to support the test
- Prototypes of replacement technology fielded in parallel with legacy systems
- Add-on experiments at each lab

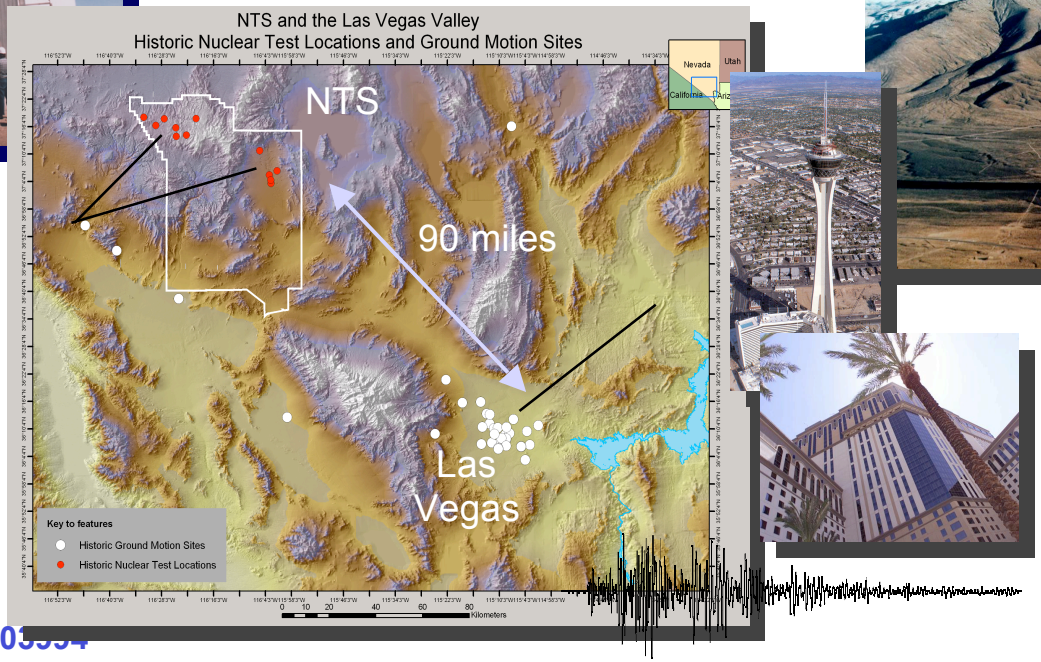
While other issues exist, V-division only deals directly with diagnostics



Canister

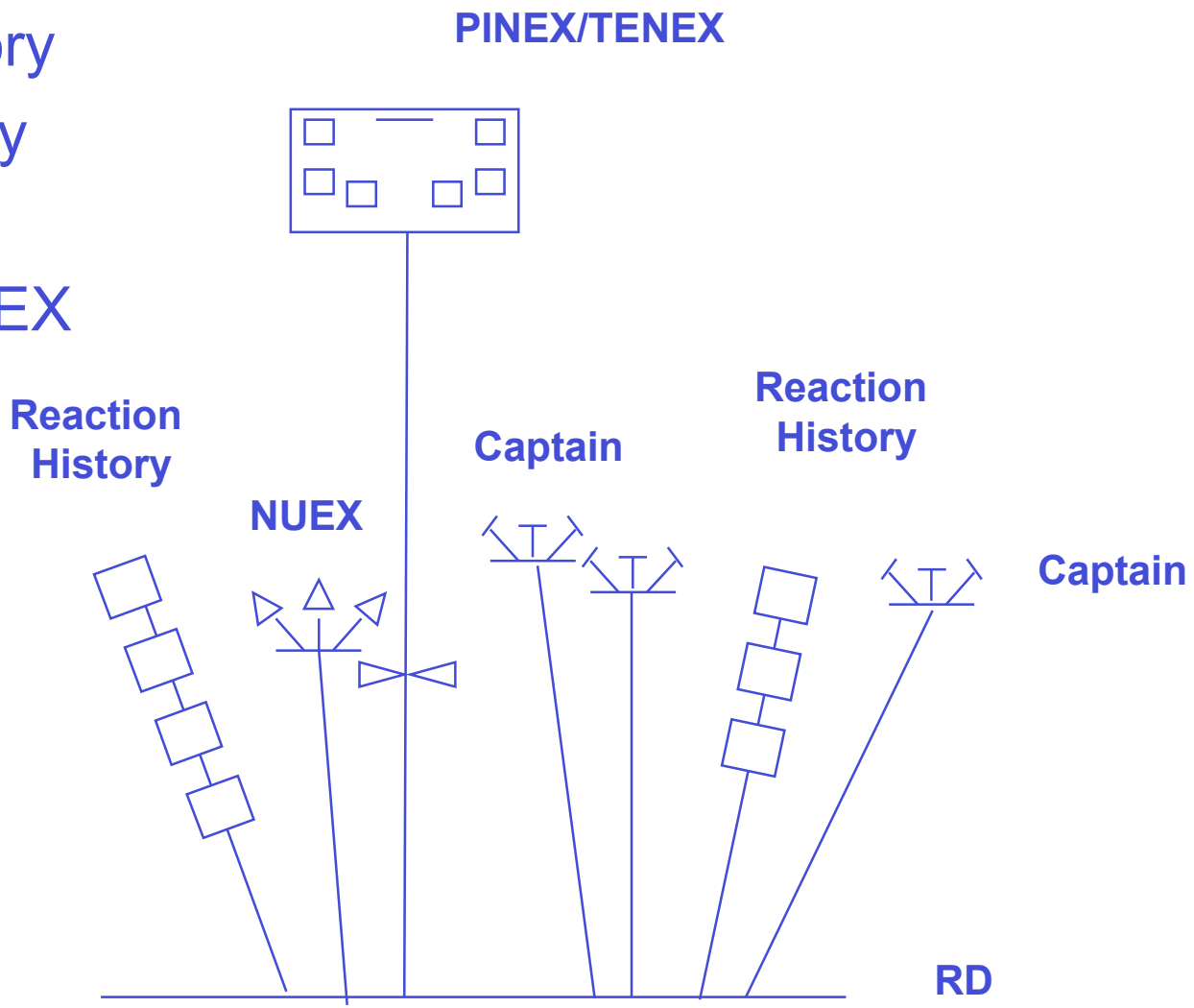
Containment

Seismic



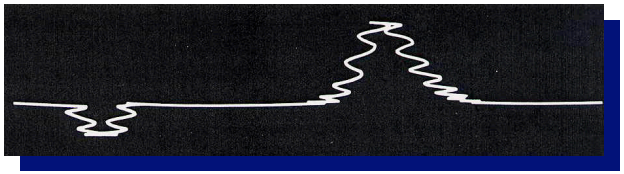
A moderately complex test requires a suite of diagnostics

- Reaction History
- Radiochemistry
- PINEX
- Captains/THREX
- NUEX
- Others



For the current TR diagnostics funding, we can…

- Reconstitute Reaction History
- Reconstitute limited PINEX



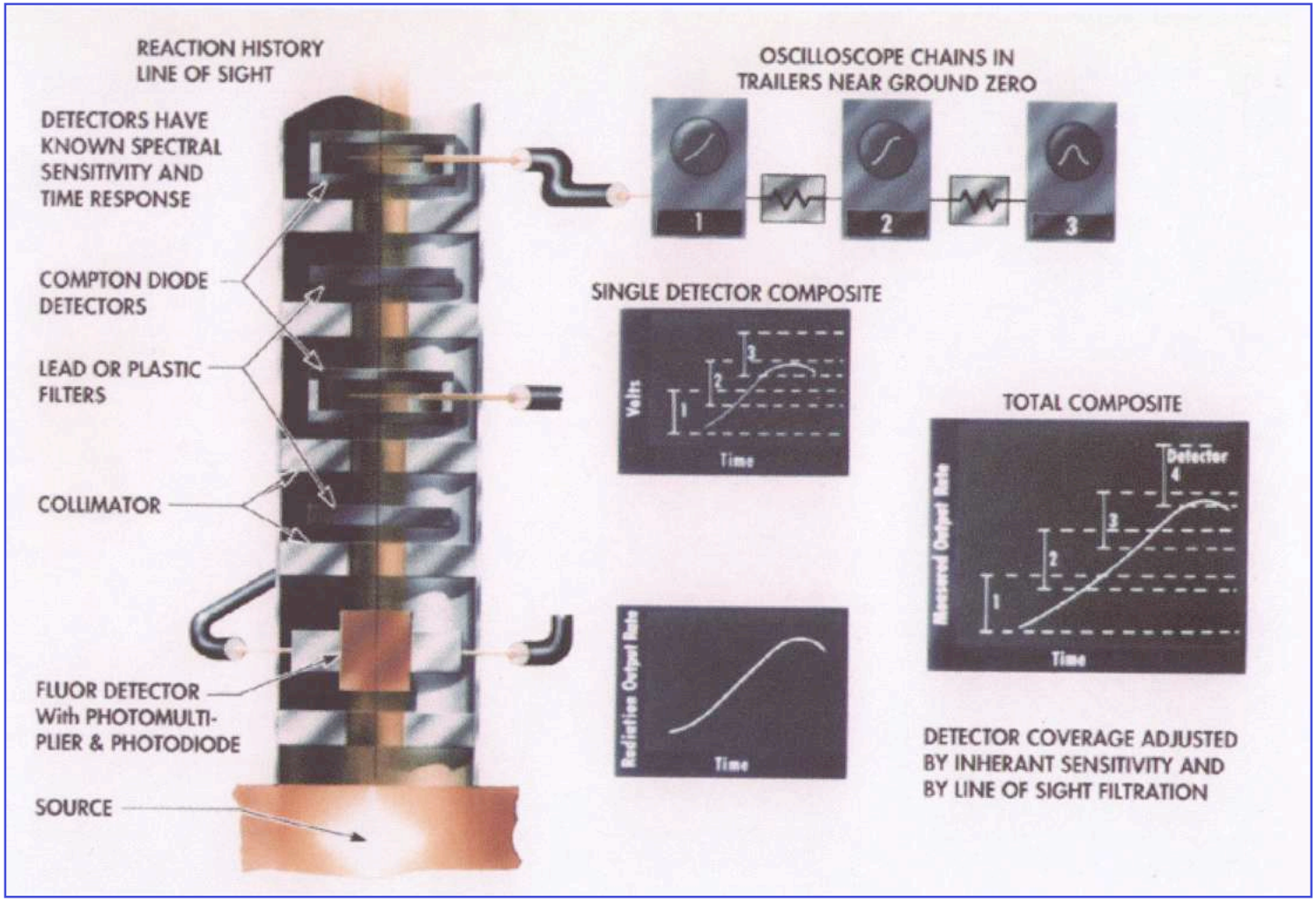
- Reconstitute radiochemistry
- Delayed Captains/Threx to Sept. 30, FY07
- NUEX may be supported in 18 months

Achieving a 24 month posture on diagnostics involves several hurdles

- There are limited supplies of legacy equipment.
  - 2-3 shots maximum
- The equipment that does exist is old and increasingly unreliable.
  - Testing
  - Replacement
- Key items
  - Rossi scopes
  - PINEX cameras
  - Cable (800k feet RF-19)

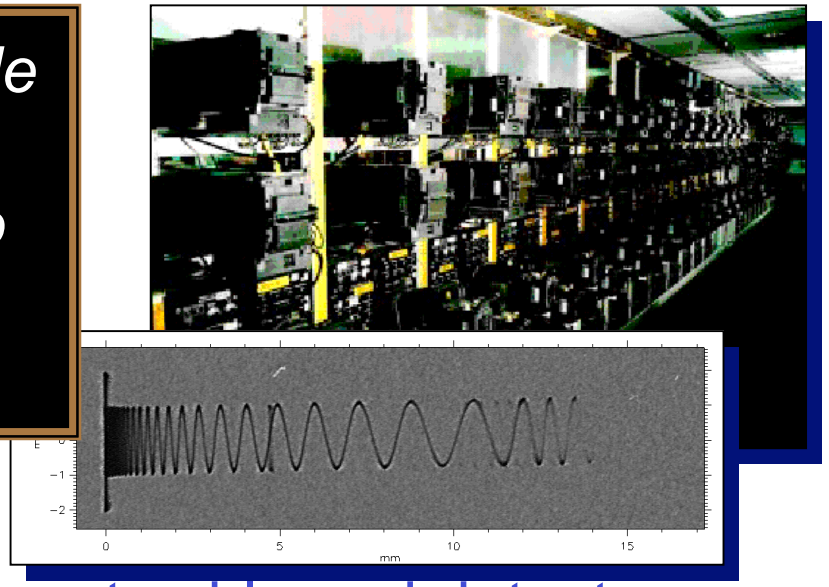
Designers always want better resolution in every variable

Reaction History is a measurement of the gamma rays over time.



Reaction History tasks

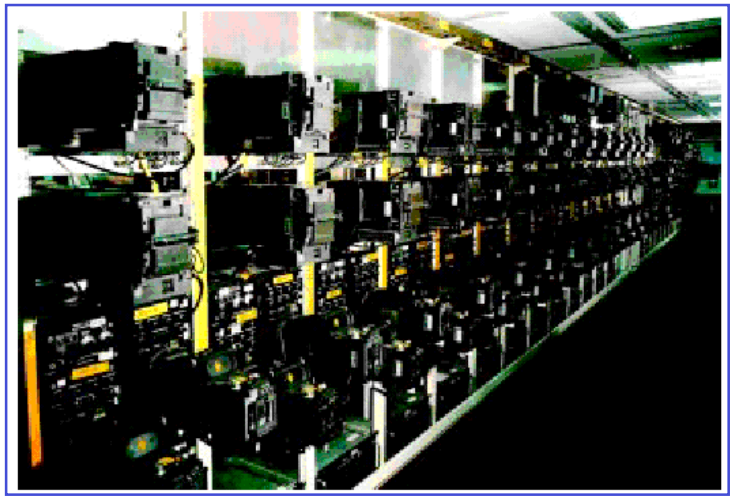
Goal: to develop the people and required component replacement technology to field reaction history on an underground nuclear test



- Identify and qualify replacement cable and detectors
- Evaluate digital techniques for RH measurements
- Identify film or CCD replacements for scope cameras
- Develop high bandwidth reaction history
- Line-of-sight calculations

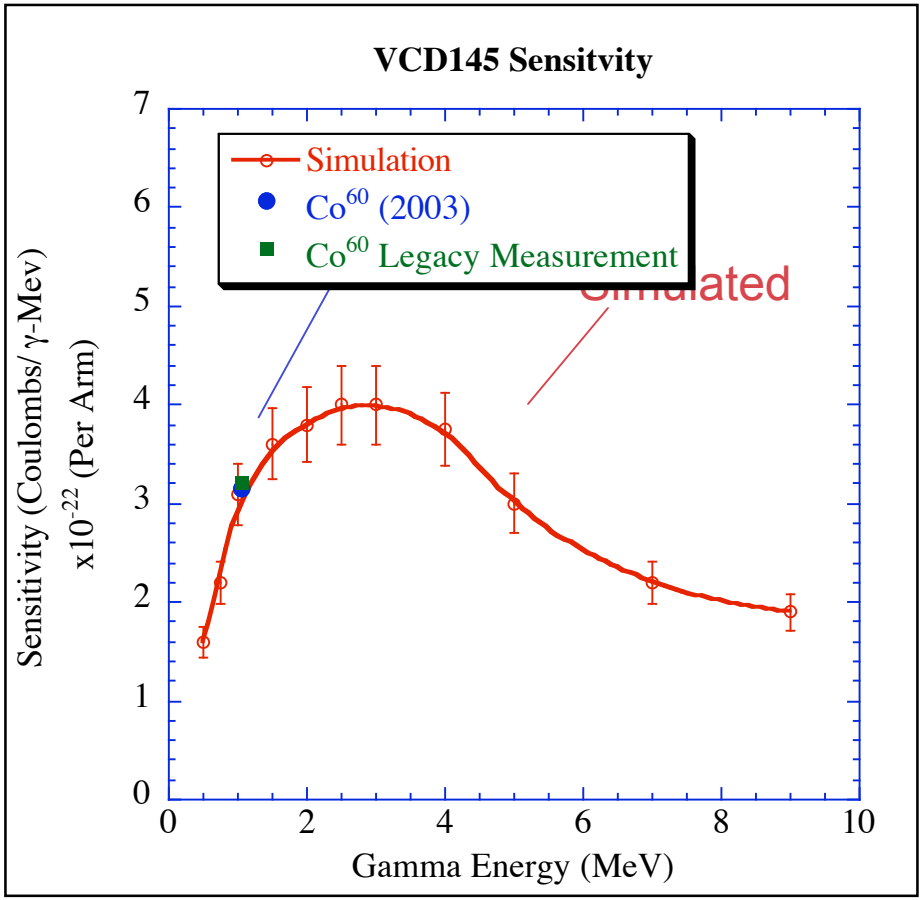
We looked into the present status of the legacy equipment.

- VCDs
  - At least one of VCDs is no longer
  - under vacuum.
  - Inventory reliability is in question
  - BN to manufacture new ones
- Cable (RF-19)
  - Sitting in desert for 10 years
  - Deteriorating insulation
- Rossi Scopes
  - Recent BN tests look promising

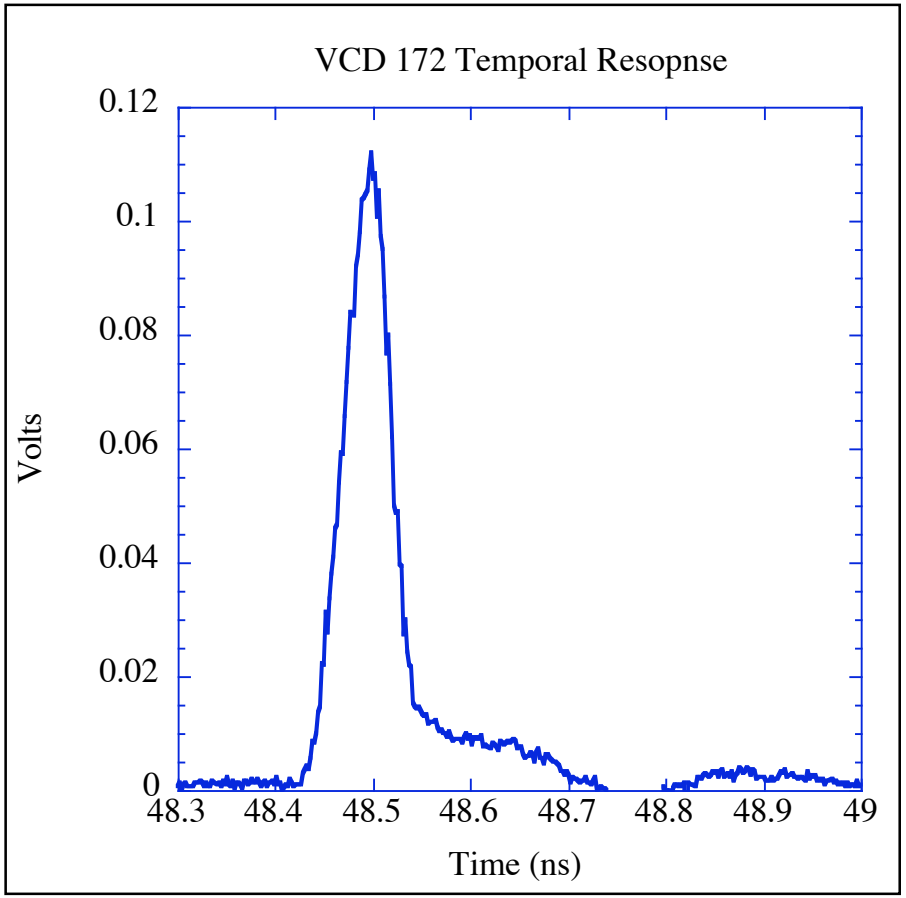


We are reconstituting the ability to calibrate detectors.

Photometric Sensitivity

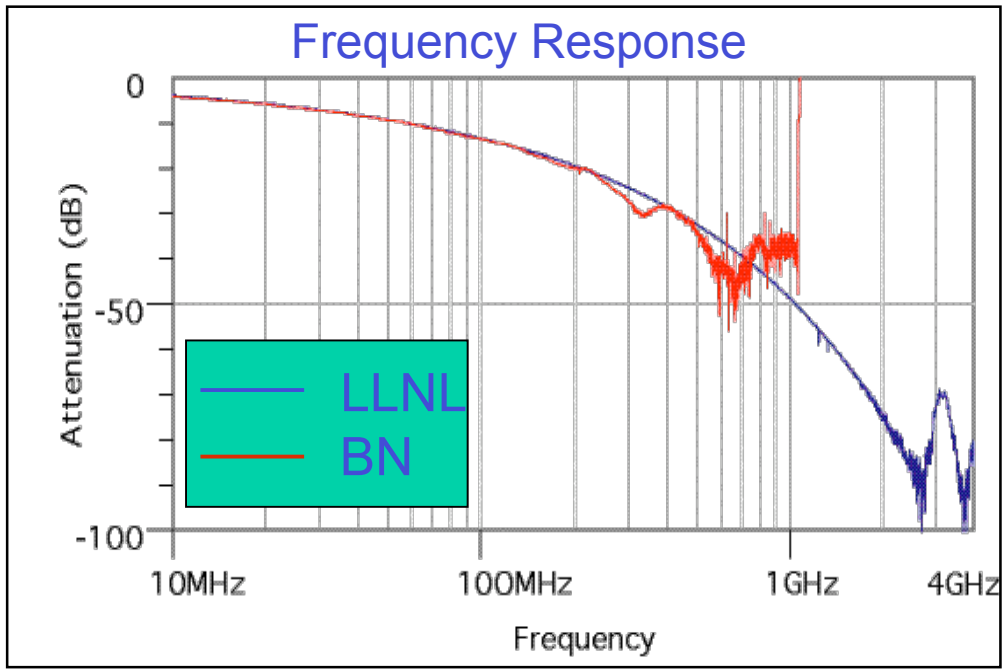


Legacy Temporal Response



We are investigating the status of the stockpile of RF-19 Cable

- Mechanical Properties unknown
- Failed gas block



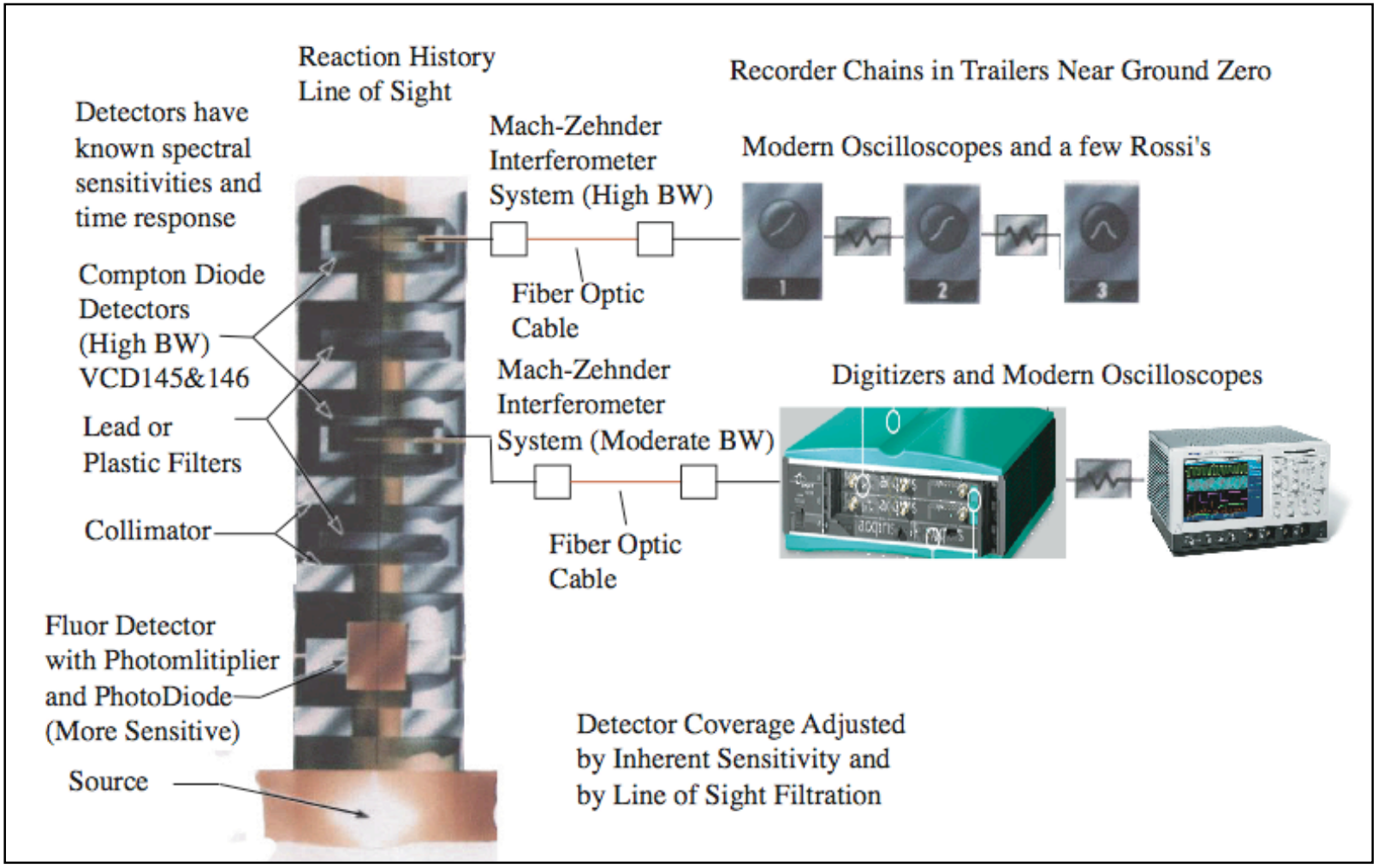
Passed High Voltage

20 kV for 1 min

I(leakage) ~ 0.5 uA,

I(minimum) ~ 21.4 uA

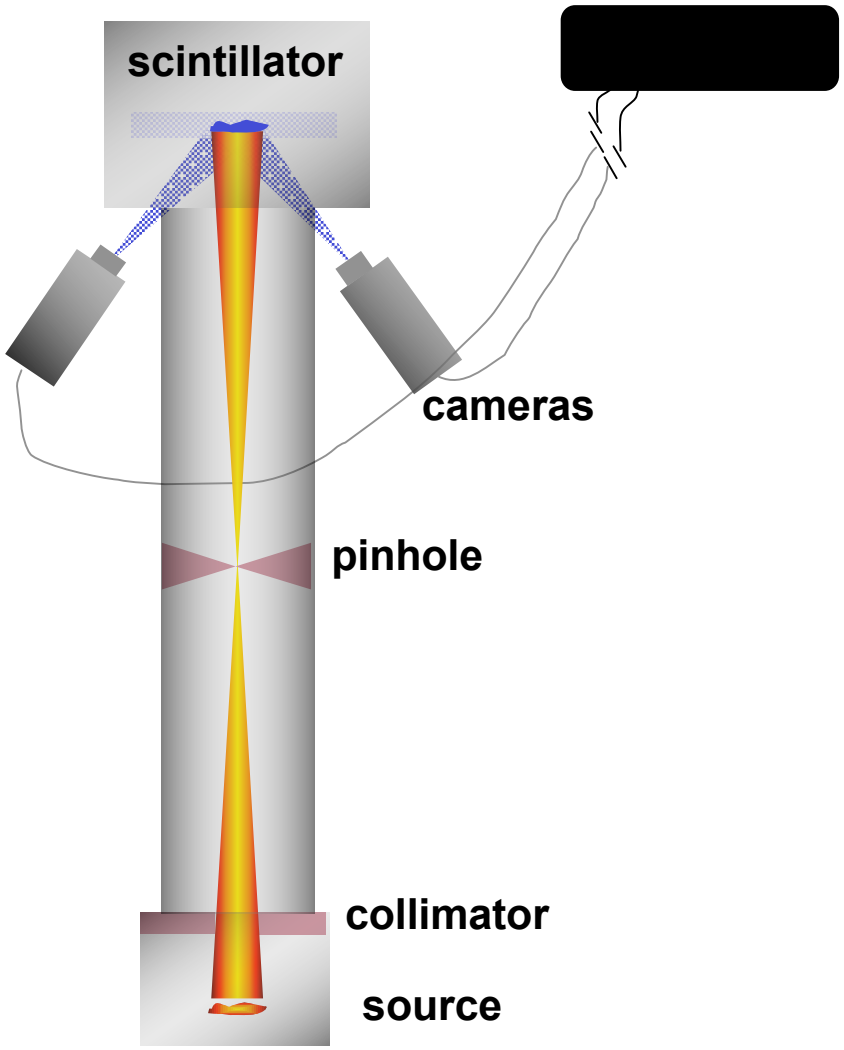
The Modern Reaction History Measurement

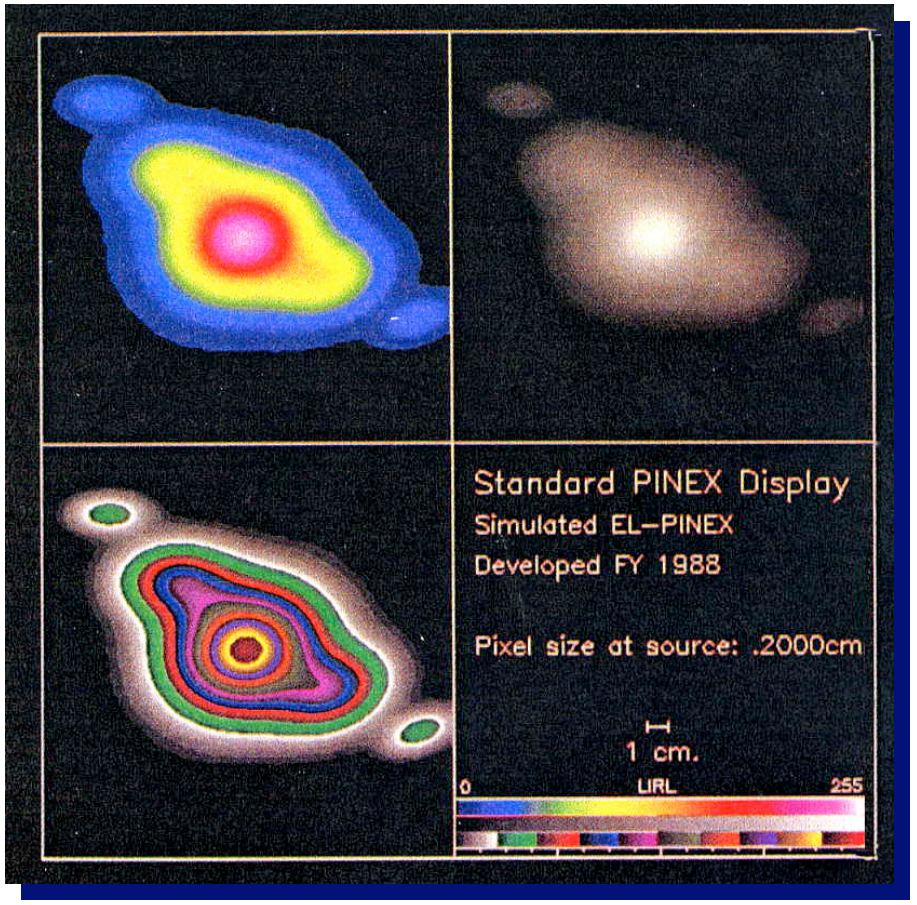


Reaction History accomplishments

- Completed first calibration of a vacuum Compton diode since the end of testing
- Developed ability to run GNARM for determining detector signal levels for lines-of-sight
- Completed high-frequency characterization of legacy RF-19 cable; designing and simulating prototype equalizer components
- Completed high bandwidth component survey
- Evaluated three digitizers for possible Rossi replacement

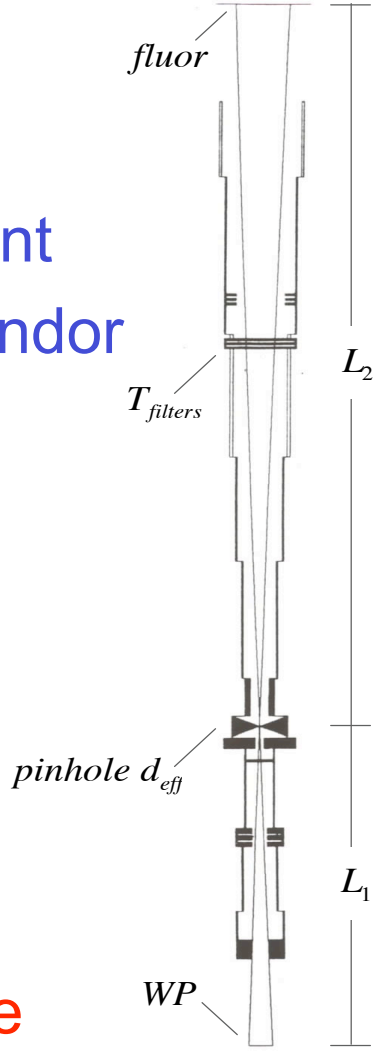
PINEX: a pinhole camera image of the device neutron emission





PINEX tasks

- Develop new fast readout camera
- Identify and qualify scintillator replacement
- Identify and qualify replacement MCP vendor
- Develop modern data acquisition system requirements
- Evaluate status of data acquisition components
- Evaluate pinhole fabrication



The cameras are a critical issue

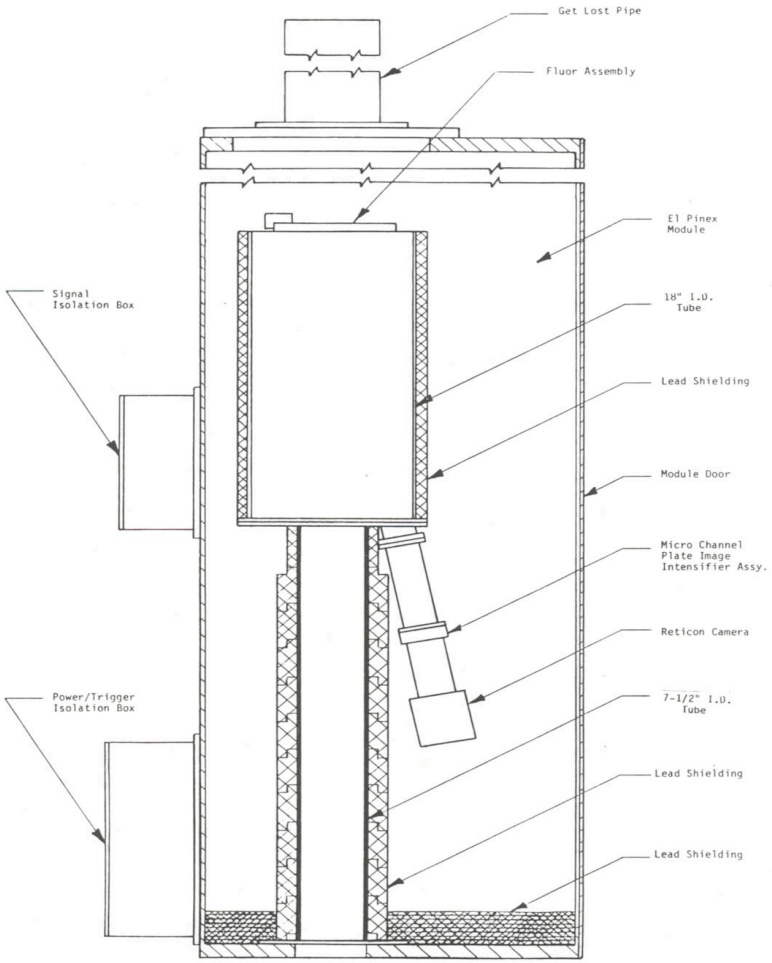
Only enough legacy cameras for 2 tests, so a replacement is needed.

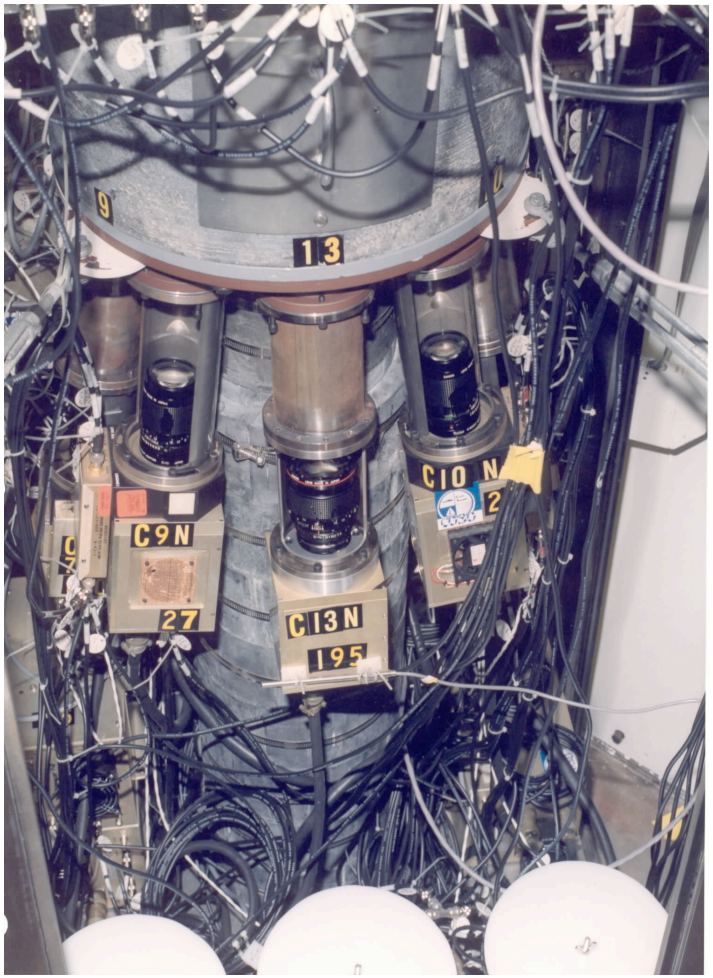
- Legacy 128 x128 Reticon Diode Arrays
  - Image readout in approximately 2 msec before shock destroys the cameras.
  - High radiation background.
  - Moderate resolution (~400μm-500μm)
  - Moderate dynamic range (~100)
- Replacement Specification
  - Image readout in approximately 2 msec before shock destroys the cameras.
  - High radiation background.
  - Improved resolution (200μm-300μm)
  - Increase dynamic range- (~1000)
  - Time resolution- 2-3 ns

Our approach is to field both legacy and developmental systems

- ANY new system should be bench-marked!
  - Shots will most likely be rare if program is restarted
  - Previous systems were time tested
  - New people + New system+ Added features = (…)
- New system is required to move forward
  - Readout cameras with better spatial resolution
  - Faster data acquisition
  - Much more storage capabilities

Using new cameras makes radiation hardness an issue

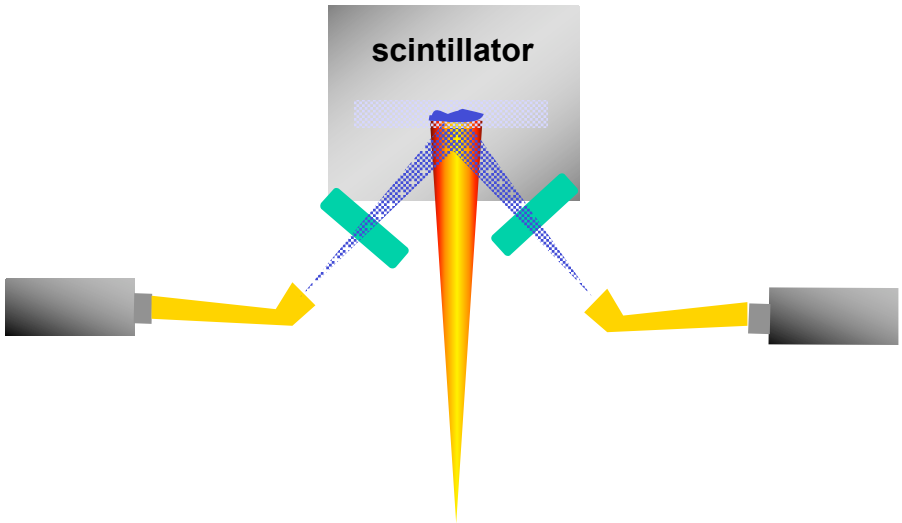




- Courtesy of J. Hall

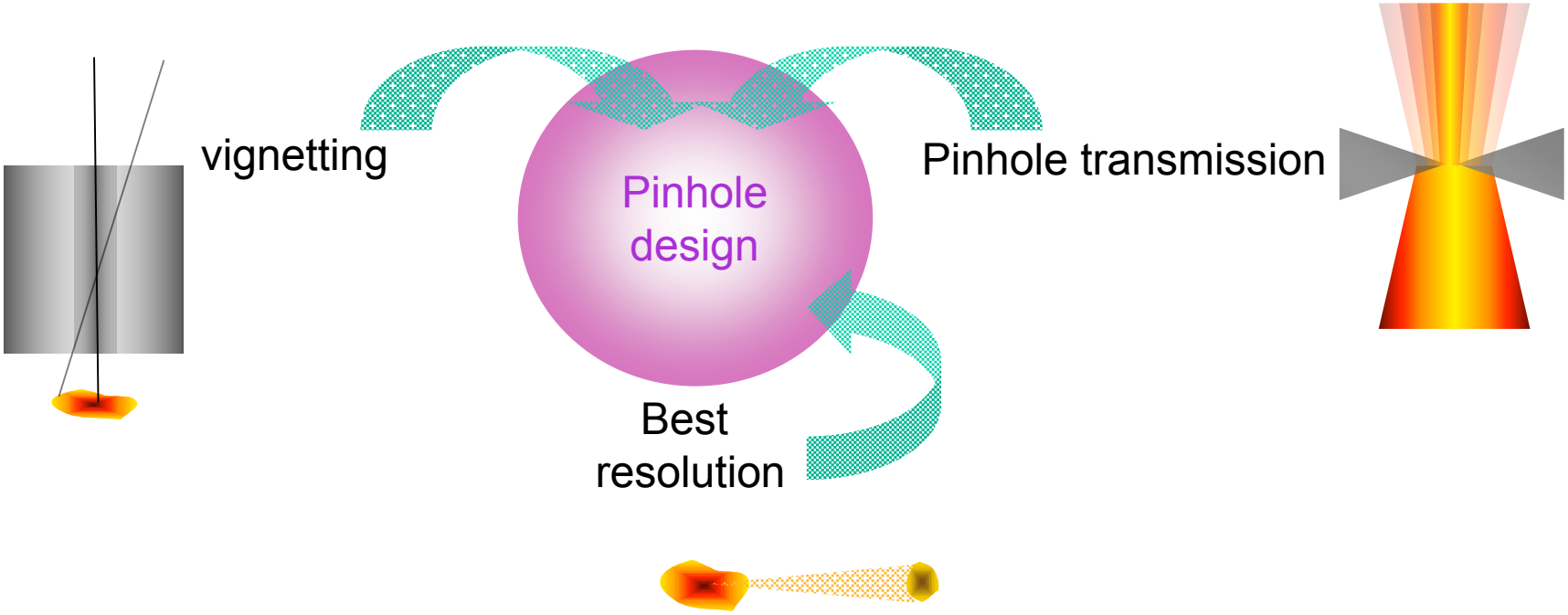
Using new cameras makes radiation hardness an issue

- Tests on the neutron susceptibility of the CMOS cameras are being designed.
- The system we will use will use a short fiber optic relay to rotate the camera chip away from the scintillator to minimize potential “starring”.



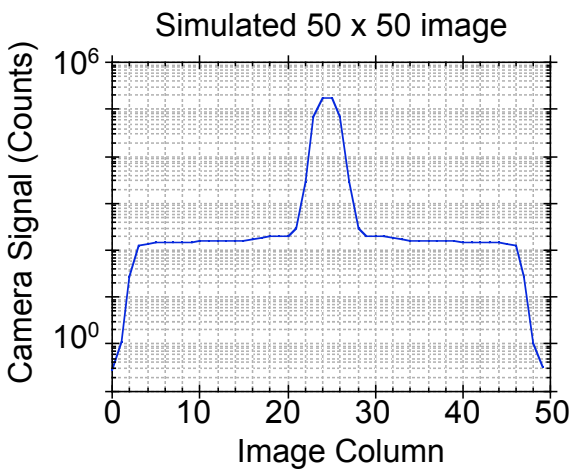
Pinhole considerations play an central role in the design

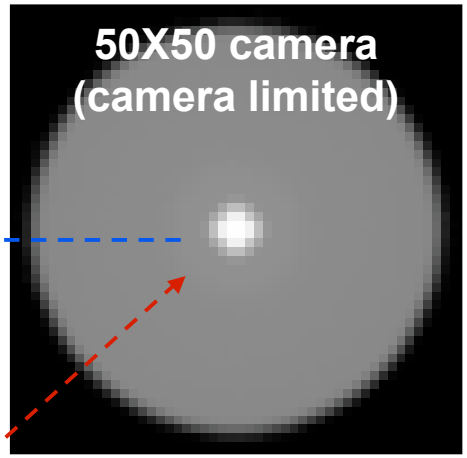
- The pinhole is the limiting factor in the system resolution
- The pinhole is the limiting factor in the source solid angle



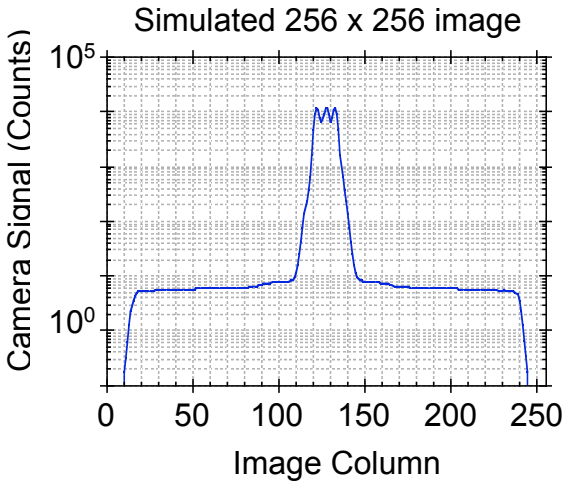
We are investigating newer designs used on OMEGA

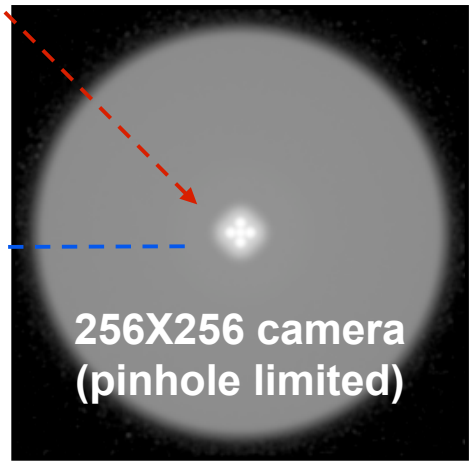
We are using Monte Carlo simulations to investigate resolution





Source hot spots





> 512 x 512 does not help due to other limitations

2.50 cm Ø source
0.014" pinhole @ 250"
fluor @ 1000" (M = 3:1)

Also aiding in determining scattered signals

PINEX Accomplishments

- Established baseline camera resolution requirements
- Developed preliminary PINEX design based on commercial chip technology
- Developed neutron testing plan for commercial chip
- Completed preliminary optical characterization of commercial system—failed
- Completed preliminary design of data acquisition system

Spin-off collaborations:

- Jasper pin upgrade
  - Improved high-speed electronics for the EOS experiments.
- Fiber re-circulator tech base project
  - May allow ~40-GHz (analog bandwidth) sampling a transient.
- Alpha Box
  - Portable Reaction History Detection